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ABSTRACT

This study, part of ongoing research to establish the construct validity of a science attitude assessment instrument, evaluated the instrument with 72 elementary school science teachers. The measure, "Assessment of Attitude Toward Science and Science Teaching," contains 27 statements to which the respondent expresses degrees of agreement. This particular investigation examined use of the instrument to reveal whether the teacher-respondent was constructivist in approach to science and science teaching. Factor analysis determined that four factors accounted for 50 percent of the variance. These were: (1) understanding science; (2) constructivist approach to teaching and learning about science; (3) attitudes towards teaching science; and (4) positive attitudes towards science. Agreement with statements loading on the first and fourth factors were interpreted as identifying a more traditional science teacher, while disagreement with these statements suggested a more constructivist approach. Agreement with statements loading on the second and third factors indicated a more constructivist bent, while disagreement indicated a more traditional approach to science. Appendices include the instrument and the statistical analyses. (DB)

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ED 413 841

A Constructivist Interpretation of Attitude Towards Science

Abstract

A science attitude assessment instrument used with elementary science teachers was examined and data from seventy-two teachers taking the assessment in 1996 were intercorrelated and factor analyzed to see if the instrument could reveal if they were constructivist in their approach to science and science teaching. Factor analysis revealed four factors accounting for 50% of the variance (understanding science, constructivist approach to teaching and learning science, attitudes towards teaching science, and elitist attitudes towards science). Agreement with statements loading on the first and fourth factors could be interpreted as identifying a more traditional science teacher while disagreement with these statements would indicate a more constructivist approach. Agreement with statements loading on the second and third factors indicates a more constructivist bent while disagreement would indicate a more traditional approach to science. This is part of an on-going study to establish the construct validity of this instrument for this new purpose.

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Part I: Background

Purpose

"Constructivism" has become the dominant voice in science education today. There are, however, few ways to measure just how "constructivist" science teachers really are. Moore and Sutman (1970) designed an instrument to measure student attitudes toward science and Moore later (1973) modified that instrument for use with elementary teachers. Since then the content of the statements on the assessment have been modified and the number of statements reduced from 60 to 27. (Instrument is included as **Appendix A**.) Since the original work done to establish the construct validity of the instrument in the early seventies, the instrument as it now exists has not been examined closely.

The purpose of this study was two-fold: 1) study the revised instrument and re-establish its construct validity; and 2) look at the data obtained using the instrument to see if they could reveal teachers' "constructivist" tendencies, thereby adding to the instrument's usefulness to researchers.

Perspective

Whether one views "constructivist" science teaching from the approach of Bybee (1995), Aldridge (1995), and Yeager (1991), where the teacher still has a lot to say in what is studied in the science classroom, or from a more post-modern approach that would see the curriculum as student-driven, is not an argument of concern to this study. Instead, constructivism is more appropriately considered as an alternative to "traditional" ideas about science (positivist, reified, absolute, even elitist). Constructivist science teachers usually differ from those following a more traditional approach in two major ways: they have a different

philosophical view of science as a whole, and their pedagogical approach to teaching science reflects this different view.

Philosophically, constructivist teachers view science as a process for exploring the natural world that generates as many ideas and further questions as it does specific answers to current problems. It is viewed as an enterprise continuously "under construction" where today's explanations can be replaced if new information reveals them to be inaccurate. Science and the knowledge generated from scientific pursuits is in constant flux, contingent on available information. The more we learn, the more we realize we do not have all the answers and probably never will have.

Pedagogically, constructivist science teachers realize that all knowledge is constructed from students' own experiences. They therefore teach science from a "hands-and-minds on" approach (Clough & Clark, 1994; Hwangbo & Yawkey, 1994). They see themselves as facilitators and guides, not dispensers of knowledge. Science is viewed as an enterprise valuable to society and a knowledge of how it works as essential to individual literacy as being able to read, write, or calculate. Constructivist science teachers believe all children can "do" science; it is not an elitist activity, capable of being understood only by a select few. It's products are new ideas, not just more facts to memorize. Students actively construct their own science knowledge, meaningful to them, under the guidance of a teacher rather than the teacher, alone, making the decisions as to what is "necessary" for them to learn and then simply devising lessons to "teach" that information.

Part II: Method

Analysis

Data were obtained from seventy-two elementary school science teachers who were asked to complete the 27-statement instrument during the summer of 1996. Descriptive statistics were run on the data (**Appendix B**) and summarized (**Appendix C**). The responses of the seventy-two teachers were inter-correlated with the item totals (**Appendix D**) and five items were found to have low inter-correlations. The entire instrument was then factor analyzed using a principal components analysis (Feldman, et. al., 1987). Four factors were defined by a root-curve analysis and transformed to an oblique, simple structure using Hofmann's (1978) orthotran solution (**Appendix E**). Coefficient alphas were then calculated for each separate factor.

Results

Using factor analysis, five items were shown to have low correlations to the total scores for those items: items 2, 7, 11, 17, and 22. (See **Appendix D**.) A coefficient $\alpha = .751$ was increased to $\alpha = .778$ through the elimination of these items. A look at the wording of these items reveals them to be somewhat ambiguous. Items 17 and 22 have fairly high coefficients of variance (49.1 and 50.61, respectively) indicating individual teachers were probably interpreting these items very differently.

The four factors accounted for 50 percent of the total variation. The first transformed factor was the strongest factor accounting for 18% of the variance; the third transformed factor accounted for 13% of the variance; the second accounted for 11% of the variance; the fourth accounted for 8%. The statements associated with Factor I defined an alpha reliability

of .81 while the statements for the subsequent Factors II, III, and IV defined alpha reliabilities of .73, .67, and .65, respectively.

Factor Interpretations

Factor I, α = **.81**, can be summarized as the "Understanding Science" factor. An answer signifying strong agreement with one of these statements could be interpreted as displaying a lack of understanding about science. Statement #6 ("I do not understand science, and I do not want to teach it.") loaded most strongly on this factor (.818), with Statement #21 ("I just will never understand science.") a close second at .808. Disagreeing with these statements could be interpreted as having a better understanding of the nature of science and a less reified concept of science, a much more constructivist viewpoint.

Factor II, α = **.73**, can be summarized as the "Constructivist Approach to Teaching and Learning About Science" factor. Statements #12 ("His or her senses are among the most important tools a scientists has.") loaded at .826, while statements #14 and #13 ("Ideas are one of the more important products of science." and "Science may be described as being primarily an idea-generating activity.", respectively) loaded at .679 and .606, respectively. Statement #15 ("As children experiment, a teacher should give helpful hints, but not answer the problem.") also correlated with this factor (.500). In general, agreement with these statements indicated a constructivist view, while disagreement could be seen as being "anti-constructivist."

Factor III, α = **.67**, dealt with "Attitudes Towards Teaching Science." Statement #18 ("I like science and I probably am a better science teacher than most other teachers.") correlated at .707, with Statement #16 ("Science is pretty easy to understand.") a close second at .635. Teachers agreeing with these statements were seen as having positive attitudes

towards teaching science, a more constructivist view, while those disagreeing with these statements had a more negative view about teaching science and therefore could be seen as "anti-constructivist."

Factor IV, $\alpha = .65$, dealt with "Positivist Attitudes Towards Science." Factor 4 loaded most heavily (.701) on Statement #3 ("Most people are *not* able to understand the work of science.") Statements #4 and #5 ("When something is explained well, there is *no* reason to look for another explanation." and "The products of scientific work are mainly useful to scientists; they are *not* very useful to the average person.") loaded at .653 and .599, respectively. This pattern of loadings leads to the conclusion that agreement with statements loading on this factor reveal a negative attitude towards science, while disagreement would indicate a more positive attitude towards science.

On the 16 of the 27 items that loaded on the pro-science (items 9, 11, 16 through 18, and 20), constructivist (items 2, 12 through 15, and 23 through 27)) factors, teachers indicated support for a constructivist approach to teaching science, averaging 2.31 for those 16 items. The average for the 10 constructivist items was 2.51. The average for the 6 pro-science, but more positivist, items was 1.97. Their highest averages were for items 12 ("His or her senses are among the most important tools a scientist has.") and 26 ("Scientific explanations can only be made by scientists."), at 2.9 and 2.8, respectively. The lowest item averages were for two positivist items, 16 ("Science is pretty easy to understand.") and 17 ("A major purpose of science is to produce new drugs and to save lives."), at 1.6 and 1.5, respectively.

On the 11 of the 27 items that were anti-science (Factor I) or anti-constructivist (factor IV), the average was 2.48, indicating a "constructivist" response to these items. For the 6 items that were considered anti-science (6, 7, 8, 10, 19, and 21) the average was 2.55,

indicating a favorable attitude about science. For the 5 that were considered anti-constructivist (1, 3, 4, 5, and 22), the average was 2.4, indicating a preference for a constructivist approach.

In summary, teachers in this sample would seem to be fairly constructivist in their approach to science and science teaching. Further data from different groups of teachers will be used to test the results of this analysis and see if it is generalizable.

Part III: Educational Significance

It would appear this instrument can be used to measure constructivist tendencies among elementary science teachers. A modified instrument consisting of items 2, 9, 11 through 18, 20, and 22 through 27, could be used. Based on the factor analysis data, items 2, 11, and 22 should probably be re-worded to make them less ambiguous. Items 12 to 15 and 23 to 27 could be used alone as a short measure of constructivist approaches. These items could also be used when interviewing prospective teachers when constructivist teachers are being sought. The entire instrument, as it currently exists, could be used to indicate areas that might be addressed in future teacher in-services.

This work is part of an on-going study which will identify separate groups of teachers, traditional and constructivist, and use confirmatory factor analysis to determine the instrument's construct validity as a means to measure constructivist tendencies of elementary teachers. The results obtained should provide us a context within which to better understand a postmodern perspective on science teaching and learning.

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Appendix A:

"Assessment Of Attitude Toward Science And Science Teaching" Instrument

Assessment Of Attitude Toward Science And Science Teaching

Directions: After carefully reading a statement, decide how much you agree or disagree with it. Then fill in the appropriate bubble with a #2 pencil. Your choices are:
A = agree strongly; B = agree mildly; C = disagree mildly; D = disagree strongly.

Please be careful ***not*** to respond with an "E."

1. There is *no* need for the public to understand science in order for scientific progress to occur.
2. Most children should be able to design experiments - at least by the sixth grade.
3. Most people are *not* able to understand the work of science.
4. When something is explained well, there is *no* reason to look for another explanation.
5. The products of scientific work are mainly useful to scientists; they are *not* very useful to the average person.
6. I do not understand science, and I do not want to teach it.
7. After all is said and done, it is really the teacher who tells the children what they have to learn and know.
8. Before one can do anything in science, he or she must study the writings of the great scientists.
9. Every citizen should understand science because we are living in an age of science.
10. Children must be told what they are to learn if they are to make progress in science.
11. A teacher has a responsibility to teach the basic processes of science.
12. His or her senses are among the most important tools a scientist has.
13. Science may be described as being primarily an idea-generating activity.
14. Ideas are one of the more important products of science.
15. As children experiment, a teacher should give helpful hints, but not the answer to a problem.
16. Science is pretty easy to understand.
17. A major purpose of science is to produce new drugs and save lives.
18. I like science and I probably am a better science teacher than most other teachers.
19. I am afraid to teach science because I can't do the experiments myself.
20. Public understanding of science is necessary because scientific research requires financial support through the government.
21. I just never will understand science.
22. Scientists discover laws which tell us exactly what is going on in nature.
23. Scientists believe that they can find explanations for what they observe by looking at natural phenomena.
24. Scientific laws cannot be changed.
25. A useful scientific theory may not be entirely correct, but it is the best idea scientists have been able to think up.
26. Scientific explanations can only be made by scientists.
27. We can always get answers to our questions by asking a scientist.

Appendix B:

Descriptive Statistics

Attitude Towards Science - Descriptive Statistics

X_1: S1

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.43	.93	.11	.87	38.34	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	175	487	0
Mode:					
3					

X_2: S2

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.71	.59	.07	.35	21.85	72
Minimum:	Maximum:	Range:	Sum:	Sum of Sqr.:	# Missing:
1	3	2	195	553	0
Mode:					
3					

X_3: S3

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.31	.8	.09	.64	34.64	72
Minimum:	Maximum:	Range:	Sum:	Sum of Sqr.:	# Missing:
1	3	2	166	428	0
Mode:					
3					

X_4: S4

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.71	.62	.07	.38	22.72	72
Minimum:	Maximum:	Range:	Sum:	Sum of Sqr.:	# Missing:
0	3	3	195	555	0
Mode:					
3					

Attitude Towards Science - Descriptive Statistics

X_5: S5

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.75	.55	.06	.3	20.01	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
1	3	2	198	566	0
Mode:					
3					

X_6: S6

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.78	.54	.06	.29	19.32	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
1	3	2	200	576	0
Mode:					
3					

X_7: S7

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.46	.73	.09	.53	29.71	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	177	473	0
Mode:					
3					

X_8: S8

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.74	.53	.06	.28	19.39	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
1	3	2	197	559	0
Mode:					
3					

Attitude Towards Science - Descriptive Statistics

X_9: S9

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.21	.79	.09	.62	35.6	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	159	395	0
Mode:					
2					

X_{10}: S10

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.44	.79	.09	.62	32.12	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	176	474	0
Mode:					
3					

X_{11}: S11

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.68	.67	.08	.45	24.91	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	193	549	0
Mode:					
3					

X_{12}: S12

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.88	.44	.05	.2	15.38	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	207	609	0
Mode:					
3					

X_{13}: S13

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.38	.7	.08	.49	29.51	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	171	441	0
Mode:					
3					

X_{14}: S14

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.67	.63	.07	.39	23.55	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	192	540	0
Mode:					
3					

X_{15}: S15

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.68	.62	.07	.39	23.28	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	193	545	0
Mode:					
3					

X_{16}: S16

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.57	.82	.1	.67	52.2	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	113	225	0
Mode:					
2					

Attitude Towards Science - Descriptive Statistics

X_{17}: S17

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.53	.75	.09	.56	49.1	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	110	208	0
Mode:					
2					

X_{18}: S18

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.86	.86	.1	.74	46.25	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	134	302	0
Mode:					
2					

X_{19}: S19

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.53	.73	.09	.53	28.92	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
1	3	2	182	498	0
Mode:					
3					

X_{20}: S20

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.99	.87	.1	.76	43.81	71
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	141	333	1
Mode:					
2					

Attitude Towards Science - Descriptive Statistics

X_{21}: S21

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.71	.66	.08	.43	24.35	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	195	559	0
Mode:					
3					

X_{22}: S22

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.81	.91	.11	.83	50.61	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	130	294	0
Mode:					
2					

X_{23}: S23

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.15	.8	.09	.64	37.11	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	155	379	0
Mode:					
2					

X_{24}: S24

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.25	.87	.1	.75	38.58	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	162	418	0
Mode:					
3					

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Attitude Towards Science - Descriptive Statistics

x_{25}: S25

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.01	.87	.1	.76	43.2	71
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	143	341	1
Mode:					
2					

x_{26}: S26

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.78	.59	.07	.34	21.12	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	200	580	0
Mode:					
3					

x_{27}: S27

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.46	.79	.09	.62	31.98	72
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum of Sqr.:**	**# Missing:**
0	3	3	177	479	0
Mode:					
3					

Appendix C:

Summary of Basic Statistics

Summary of Basic Statistics for All 27 Items

Statement	Mean	Choice 1	Choice 2	Choice 3	Choice 4	Correlation
1	2.4	4	10	9	49	.39
2	*2.7	5	11	56	0	.24
3	2.3	15	20	37	0	.38
4	2.7	1	3	12	56	.32
5	2.8	4	10	58	0	.49
6	2.8	4	8	60	0	.58
7	2.5	1	7	22	42	.12
8	2.7	3	13	56	0	.44
9	*2.2	3	7	34	28	.35
10	2.4	2	7	20	43	.40
11	2.7	2	2	13	55	.11
12	*2.9	1	0	6	65	.45
13	*2.4	1	6	30	35	.27
14	*2.7	1	3	15	53	.43
15	*2.7	1	3	14	54	.28
16	*1.6	8	22	35	7	.33
17	1.5	7	24	37	4	.08
18	*1.9	5	17	33	17	.41
19	2.5	10	14	48	0	.54
20	*1.9	5	12	33	21	.33
21	2.7	1	5	8	58	.41
22	1.8	5	23	25	19	.10
23	*2.1	3	9	34	26	.45
24	2.3	3	11	23	35	.42
25	*2.0	5	11	33	22	.42
26	2.8	1	3	7	61	.46
27	2.5	2	7	19	44	.50

= Possible Items for deletion = Most Responses

Responses were scored on a 0-3 scale, with:

<1.5 = Non-constructivist attitude
1.5 = Neutral
>1.5 = Constructivist Attitude

* = Reflected scores

Appendix D:

Statement Elimination Data

ITERATING TO MAXIMUM INTERNAL CONSISTENCY THROUGH STATEMENT ELIMINATION.
ANALYSIS BASED ON CORRELATION BETWEEN STATEMENT SCORE AND CORRECTED TOTAL SCORE.

****

DATA FILE NAME: att.(27-all).txt
Analysis Run of Wednesday, February 19, 1997 at 12:54 PM
number of observations = 71
number of statements = 27
number of missing cases = 1
****

------- PASS 1----------
coefficient alpha = 0.740
number of observations = 71
number of statements = 27
statements eliminated because of 0 variance = none

Statement Discrimination Indices

statement	correlation with total	correlation with corrected total
1	0.40	0.28
2	0.24	0.16
3	0.38	0.28
4	0.32	0.24
5	0.49	0.43
6	0.58	0.53
7	0.18	0.08
8	0.44	0.38
9	0.35	0.24
10	0.40	0.30
11	0.11	0.02
12	0.46	0.40
13	0.27	0.17
14	0.43	0.35
15	0.29	0.20
16	0.33	0.22
17	0.08	-0.03
18	0.41	0.30
19	0.54	0.46
20	0.33	0.22
21	0.42	0.34
22	0.10	-0.03
23	0.45	0.35
24	0.42	0.31
25	0.42	0.32
26	0.68	0.64
27	0.50	0.41

23

------- PASS 2----------

coefficient alpha = 0.751
number of observations = 71
number of statements = 26
statements in order of elimination
Q17

Statement Discrimination Indices

statement	correlation with total	correlation with corrected total
1	0.41	0.29
2	0.23	0.15
3	0.40	0.30
4	0.34	0.26
5	0.51	0.45
6	0.60	0.55
7	0.22	0.12
8	0.45	0.39
9	0.33	0.23
10	0.41	0.31
11	0.11	0.02
12	0.44	0.39
13	0.26	0.16
14	0.42	0.34
15	0.28	0.20
16	0.31	0.20
18	0.39	0.28
19	0.55	0.47
20	0.29	0.18
21	0.44	0.36
22	0.10	-0.03
23	0.45	0.35
24	0.44	0.33
25	0.40	0.29
26	0.70	0.65
27	0.53	0.44

——— PASS 3———————————————————

coefficient alpha = 0.767
number of observations = 71
number of statements = 25
statements in order of elimination

Q17
Q22

Statement Discrimination Indices

statement	correlation with total	correlation with corrected total
1	0.39	0.27
2	0.24	0.15
3	0.38	0.27
4	0.30	0.22
5	0.48	0.41
6	0.60	0.55
7	0.23	0.13
8	0.46	0.40
9	0.35	0.25
10	0.40	0.30
11	0.14	0.04
12	0.46	0.41
13	0.26	0.16
14	0.44	0.36
15	0.29	0.20
16	0.31	0.20
18	0.40	0.29
19	0.55	0.47
20	0.33	0.21
21	0.46	0.38
23	0.47	0.37
24	0.43	0.32
25	0.40	0.29
26	0.70	0.66
27	0.52	0.43

——— PASS 4———————————————————

coefficient alpha = 0.773
number of observations = 71
number of statements = 24
statements in order of elimination

Q17
Q22
Q11

Statement Discrimination Indices

statement	correlation with total	correlation with corrected total
1	0.39	0.27
2	0.22	0.13
3	0.39	0.28
4	0.32	0.24
5	0.49	0.43
6	0.60	0.54
7	0.24	0.14
8	0.48	0.42
9	0.33	0.23
10	0.43	0.33
12	0.46	0.41
13	0.26	0.17
14	0.44	0.36
15	0.29	0.21
16	0.30	0.19
18	0.39	0.28
19	0.54	0.46
20	0.31	0.19
21	0.46	0.39
23	0.46	0.36
24	0.46	0.35
25	0.40	0.28
26	0.72	0.68
27	0.53	0.45

——— PASS 5———————————————————————

coefficient alpha = 0.774
number of observations = 71
number of statements = 23
statements in order of elimination

Q17
Q22
Q11
Q2

Statement Discrimination Indices

statement	correlation with total	correlation with corrected total
1	0.41	0.28
3	0.40	0.29
4	0.34	0.26
5	0.50	0.44
6	0.60	0.55
7	0.23	0.12
8	0.50	0.44
9	0.33	0.23
10	0.44	0.34
12	0.45	0.40
13	0.25	0.15
14	0.44	0.36
15	0.30	0.21
16	0.29	0.17
18	0.38	0.27
19	0.55	0.47
20	0.31	0.19
21	0.47	0.39
23	0.46	0.36
24	0.45	0.34
25	0.40	0.28
26	0.74	0.69
27	0.53	0.44

27

——— PASS 6———————————————————————

coefficient alpha = 0.778
number of observations = 71
number of statements = 22
statements in order of elimination

Q17
Q22
Q11
Q2
Q7

Statement Discrimination Indices

statement	correlation with total	correlation with corrected total
1	0.39	0.27
3	0.41	0.30
4	0.33	0.25
5	0.50	0.43
6	0.59	0.53
8	0.48	0.42
9	0.37	0.26
10	0.41	0.30
12	0.47	0.41
13	0.28	0.18
14	0.47	0.40
15	0.30	0.21
16	0.31	0.20
18	0.41	0.29
19	0.53	0.45
20	0.32	0.20
21	0.43	0.34
23	0.47	0.37
24	0.43	0.32
25	0.42	0.30
26	0.73	0.69
27	0.51	0.42

Appendix E:

Factor Analysis Data

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Factor Analysis

Oblique Solution Reference Structure - Orthotran/varimax

Statement	Factor I	Factor II	Factor III	Factor IV
1	.320	-.011	.119	.414
2	.095	.189	.088	-.321
3	.176	.092	.009	.701
4	.405	-.040	-.210	.653
5	.532	.068	-.068	.599
6	.818	-.024	.217	.186
7	.595	-.138	-.350	-.316
8	.660	.076	-.217	.340
9	-.149	.431	.469	.023
10	.593	.041	-.270	.194
11	.024	-.061	.492	-.191
12	-.058	.826	.000	-.093
13	-.185	.606	.087	-.102
14	.026	.679	.137	-.148
15	.031	.500	-.028	-.294
16	-.039	.178	.635	-.025
17	-.287	.145	.367	.000
18	.208	.095	.707	-.074
19	.783	-.066	.319	.001
20	-.106	.376	.478	-.125
21	.808	-.124	.002	-.018
22	-.074	-.095	-.155	.488
23	.053	.465	.280	.132
24	.408	.417	-.457	-.042
25	-.026	.524	.126	.156
26	.564	.582	-.220	.303
27	.377	.514	-.438	.197
	Anti-Science	Constructivist	Pro-Science, Constructivist	Anti-Constructivist

= Greatest Loading

= Conflicting Loading

Primary Intercorrelations - Orthotran/Varimax

	Factor I	Factor II	Factor III	Factor IV
Factor I	1.000			
Factor II	.018	1.000		
Factor III	.037	.088	1.000	
Factor IV	-.027	-.018	-.005	1.000